Unit–II

Q. 8. ***Explain the Principles of International code of Botanical Nomenclature (I.C.B.N.).***

Ans. The foundations of International code of botanical nomenclaute are found in Linnaeus' Philosophia Botanica published in 1751 where in he proposed certain principles of nomenclaure. Another significant work on plant nomenclaute was Augustin de Candolle's Theorie elemaintalre de la botanique (1813) which give detailed rules on pant nomenclature. However, the first organised efforts to develop a precise and simple system of nomenclaute to be used by botanists in all countries were made at the First congress the Lois de la nomenclaute botanique (laws of botanical nomenclature) proposed by Alphonse de Candolle (son of Augustin de Candolle) were adopted with some modifications as guide for nomenclature in the vegetable kingdom. These rules are known as de Candolle rules or Paris Code of 1867. The subsequent International botanical Congresses made significant contribution with regard to plant nomenclature but it was only at Cambridge in 1930 that "For the first that was international in function as well as in name" (Lawrence 1951). The rules of nomenclauute adopted at the Cambridge Congress were subjected to some changes and refinement from time to time and the current. International code of Botanical Nomenclature as appeared in 1978 was adopted by the Twelfth International Botanical Congress held in Leningrad (U.S.S.R.) in August 1975. The following information is based on the edition of the code.

The code is divided into three parts—Principles, Rules and Recommendations.

The Principles form the basis of the system of botanical nomenclature. The six principles given in this section are :

1. Botanical nomenclature is independent of zoological nomenclature.
2. The application of names of taxonomic groups (taxa) is determined by means of nomenclature types.
3. The nomenclature of taxonomic groups is based upon priority of publication.
4. Each taxonomic group can bear only one correct name, the earliest that is in accordance with the Rules, except in specific cases.

5. Scientific names of taxonomic groups are treated as Latin regardless of their derivation.
6. The Rules of nomenclature are retroactive unless expressly limited.

Q. 9. ***Explain the Botanic garden in India or Botanic Garden.***

Ans. A botanic garden is essentially a collection of living plants maintained for both pure and applied studies. The earliest botanical gardens were intended mainly for the training of medical students and for the study of drug yielding plants. During the 18th century some of the physic or drug gardens cultivated not only medicinal herbs but also many other types of flowering plants. The original concept of the Royal Botanic Gardens, Kew, however, was the cultivation of flowers for beauty and delight. During the 19th century, botanical gardens in the tropics became the centre of extensive botanical research with the result that quite a sizable number of useful plants become known or better known for their usefulness to the mankind. Just to mention para rubber (*Hevea brasiliensis*), quinine (*Cinchona* spp), coffee (*Coffea arabica*), and tea (*Camellia sinensis*) today once their detailed understanding and economic exploitation to the comprehensive studies in their botanical gardens. It is now universally appreciated that the merit of a true botanical garden lies as much in its use in botanical education and research as in the display of plants of ornamental and horticultural interest. Botanical and horicultural research is, at present, an accepted and well established sphere of activity of most of the botanical gardens of the world. Several botanical gardens also organize courses in horticultural education for the benefit of botanists, gardeners and the laymen.

Origin of Botanic Gardens :

The development of the idea of a botanical garden has been gradual. As the knowledge about plants became progressively scientific, many pleasure gardens were converted into botanical gardens. These not only became the centre of advanced learing but also began to play a vital role in the economic and aesthetic needs of various nations. For instance, the credit goes to the Bogor (Buitenzorg) Botanical Garden, Java, for providing impetus to the cultivation of cinchona, rubber and coffee; to the economic gardens of the Dutch for the cultivation of speces; and to the Oxford Botanical Garden, England, for the introduction of some of the parents of modern asters, chrysanthemums, dahlias, fuchsias, irises, narcissi and roses. In the field of fundamental research, it may be recalled, the laws of genetics were worked out by Mendel in a monastic garden in Austria. The research problems being studied by the present day botanical gardens vary from the development of the drought

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resistant varieties of plant to weed control. However, behind the apparent diversity in various lines of work lies the common function which all botanical gardens share, namely, the collection and display of, and research on, plants of medicinal, horticultural and other economic interests.

Royal Botanic Gardens, Kew :

This garden was started as private garden of Sir Henery Capel. The history of Kew as a true botanic garden beings in 1759 with appointment of William Aiton as superintendent. In 1841 the gardens were transferred from crown to the state and W. J. Hooker was appointed as Director and under his directorship the gardens were increased from 20 to 250 acres. At present it is, 'under the Ministry of Agriculture, Fisheries and Food and has increased to 300 acres. The herbarium contains 5,000,000 specimens; the arboretum 700 sp. and varieties; about 13,000 sp. and varieties under glass, while 8,000 herbaceous sp. are grown outdoor. The important publications are Kew Bulletin and Index Kewensis.

National Botanic Gardens (NBG), Lucknow :

Historically the present garden dates back to the time of Nawab Saadat Ali Khan (1789-1814), who laid out a royal garden in the picturesque surroundings along the southern bank of the river Gomti. Later on, it was improved by Nawab Wajid Ali Shan, who named it Sikanderbagh after his wife, Sikander Mahal Begum. Even today this garden is popularly known as Sikanderbagh. For a long time the garden existed as Government Horticultural gardens and continued to be a centre of horticultural activities in Uttar Pradesh. In 1948, the State government approved the re-organization of the Government Horticultural Gardens into the National Botanic Gardens which was ultimately taken over by the Council of Scientific and Industrial Research (CSIR) in 1953. At present, the main garden occupies an area of 27 hectares.

Since its take-over by the CSIR, the initial activities of NBG have mostly been of a formative nature, which of late have been re-organized, with a number of research laboratories having facilities for both fundamental and applied research. The gardens have a conservatory for shade-and moisture-loving plants, Fern House, Palm House, Cactus House, Orchid House, Vinetum, Citrus Orchard, Arboretum, and a large collection of different ornamental plants. The laboratories for floriculture and Plant propagation, Plant Bredding, Cytogenetics, Radiation Biology, Plant Morphology, Entomology Viticulture, Mycology and Utilization Research, are located in the garden, while the new

building, situated at the eastern end of the garden, houses Tissue culture, Virology, Plant Physiology, Floristic Botany, Pteridology, Algae, Pharmaco-botany, and Phytochemistry laboratories, besides a large Herbarium with 85,000 specimens, a well stocked library having books on all branches of botany, horticulture and allied subjects, and modern auditorium.

In brief the main functions of NBG are :

1. Collection, introduction and propagation of plants of ornamental, industrial, medicinal and other economic importance.
2. Maintenance of the botanic gardens at Lucknow and organizational of its field stations and sub-centres.
3. To conduct studies in plant improvement, pharmacobotany, aromatic and oil yielding plants.
4. Study of growth, flowering and pre-and post-harvest physiology.
5. To develop control measures for diseasea and parts of ornamental and economic plants.
6. Setting up of a herbarium, especially of economic plants.
7. Organization of a botanical museum to display the achievements of NBG and other interesting facts of plant life.
8. To exchange plants and plant material with scientific institutions and Universities in India and abroad.
9. To conserve rare and interesting plant species.
10. To serve as a centre of advance training in gardening and systematic botany.
11. Dissemination of technical information; and to advise and assist in identification, cultivation; and economic utility of plants, garden lay-out, land scaping, etc.
12. Publication of scientific and semi-popular literature for the benefit of research workers, industrialists and the laymen.

Lloyd Botanic Garden, Darjeeling : In 1878 Lloyd donated a piece of beautiful land with an are of 40 acres which was developed as a branch establishment of the Royal Botanic Garden, Culcutta. There is good collection of exotic species from China and Japan and representative plants from North Western India, Burma and Nilgiris.

Indian Botanic Garden, Culcutta :

Introduction : The Calcutta garden is in the category of gardens started for economic reasons and then growing into scientific institution. It was Roxburgh who made the rest of the word interested in the botany of India's

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immensely rich and varied flora, at that time new to science and to horticulture. It was also Roxburgh who brought the Botanic Gardens to life and made them world famous, bringing both live plants and dried material for the Herbarium from all over India so that students could study them in one place.

The site of the garden was perfectly flat; it had none of the topographical features which help to make the beauty of a garden. George King sezied the opportunity presented by its ruinous condition to set about creating them artifically. For example, he got rid of the new swamp by excavating a number of artificial lakes, and he made use of the large quantity of soil from these excavations to give the gardens several different levels, to endow it with small hills, slopes, little valley. it any garden designer ever created his land scape from the ground up, King did so at Calcutta.

Although King is remebered in Indian Botanical Garden as its chief horticultural designer, he was also an excellent botanist, it was he who, in 1887 started publishing the Annals of the Royal Botanic Gardens, Calcutta; still more important, in 1890 he initiated the Botanical Survey of India.

Dr. Mitra, a botanist but also the first landscape gardener to become Director since King, used the garden in his teaching course in landscape gardening design as a superlative example of its kind.

The Great Banyan Tree : The outstanding feature of interest of Indian Botanical Garden is the great Banyan Tree. This specimen of *Ficus bengalensis* is certainly one of the largest living creatures in the world and it may well be the largest in terms of sheet bulk of tissue. It is about two centuries old. This species of *Ficus*, drops aerial roots from its branches, which, rooting themselves them they reach the ground, in time form subsidiary trunks. This great Banyan Tree possesses about one thousand trunks and the walk round the tree is about quarter of a mile. It is still growing vigorously. It is about 100 feet high. The canopy of tree covers four acres of ground.

Palm Houses : The palm hosues in the garden are interesting. In the climate of Calcutta such houses are not, of course, necessary to exclude cold but to exclude excessive sunshine; glass would be quite inappropriate. They are elegantly shaped metal structures prefabricated in England in the nineteenth century, covered with wire netting, and over grown with a number of interesting and pretty climbing plants whose foliage provides the shade for the collection of rare palms, ferns, and noisture or shade-loving plants inside.

About forty species of palms are grown and this collection includes some fine specimens of an interesting rarity, the branching palm *Hyphaene thebaica;*

branching monocotyledons are an exception to the rule for their kind. One of the Garden's best vistas is through the Palmetum.

Ornamentals : There is a beautiful collection of ornamental leguminous trees. The Garden's specimens of *Saraca declinata* and *S. indica*, the first a mass of rich orange flowers, the other scarlet; and of its avenue of *Brownia* and *Amherstia.*

A special flower garden is devoted to cultivation during the Bengal winter, of European summer garden flowers, chiefly for the guidance of private, and institutional gardeners. Remarkably good results are obtained with many of these exotics in the very difficult climate of Calcutta, but some for example roses are far from easy to grow, and with these the Botanical Garden does useful work in selecting the varieties best able to tolerate the local conditions.

Nursery : The big propagation nursery is one of the best in Asia, and although it is maintained to supply the Botanical Garden's need for replacement plants, the surplus of young plants, is available for sale to the general public and other institutions.

Succulent Plants : The pleasantly planted garden of succulent plants, Euphorbiaceae and Cactaceae, has one especially interesting and attractive plant belonging to the genus *Pereschia*, a cactus which has tree leaves, it is a tall, woody shrub with the exceptionally beautiful flowers.

List of Great Botanic Gardens of the World

Europe :

Padua, Pisa, Palermo and Villatanto botanic gardens of Italy; Glasnevin botanic garden of Ireland; Jarden Das Plantes and Les Cedres botanic gardens of France; Leyden botanic garden of Netherland; Meise botanic garden of Belgium; Royal botanic garden of Edinburgh, Scotland; Munich, Berlin and Dahlem botanic gardens of Germany, Oxford and Kew botanic gardens of England; Belvedere and Schenbrunn botanic gardens of Austria; Uppsala and Gateborz botanic of Scandinavia.

North-America :

Arnold Arboretum, Brookyn, Long-wood, Missouri, Strybing Arboretum, Huntington and Fairchild botanic gardens of U.S.A.; Montreal botanic garden of Canada.

Russia :

Moscow, Kiev, Tashkent, Minsk and Yalta botanic gardens of Russia and other allied countries.

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Tropics :

Bogor botanic garden of Java; Singapore; botanic garden of Singapore; Entebbe botanic garden of Uganda; Peradeniya botanic garden of Ceylon; Indian botanic gardens, Calcutta India; Rio-de-ja-neiro botanic garden of Brazil.

Southern Hemisphere :

Christ Church botanic garden of Newzealand; Kirstenbosch and Stellenbosch botanic gardens of South Africa, Japan botanic gardens of Japan; Melbourne and Sydney botanic gardens of Australia; Buenos aires botanic garden of Argentina.

Importance of Botanic Gardens :

In 1889 Torrey Botanical Club in New York passed a resolution which itself reveals the importance of botanic gardens. The resolution was "The uses of a botanic garden may be reckoned as of four sorts. First and foremost is the purely scientific and educational use. Subsidiary to this but still of marked degree of importance are pharmaceutical and horticultural uses and lastly the general use as a place of agreeable resort for the public at large".

The botanical gardens are very much helpful in science of taxonomy. They are also acting as research stations in exploring the flora of native and other regions. The botanic gardens can also be used as conservatories.

They act as acclimatization station for the introduction of economically valuable plants.

The botanic gardens also play an important role in the field of horticulture.

The botanical gardens act as 'outdoor laboratories' for the students of Botany and give practical information about plants.

Q. 10. ***Define palynology. Point out its role in solving taxonomic puzzles.***

Ans. Palynology–the new upcoming science has provided new dimension to complicated fabric of taxonomic *scientia ambilis*. The significance of pollen attributes in taxonomy has been widely realised. Recent palynological data are finding increasing application in construction of diagnoses of new species. Diagnoses based on pollen features have been found in agreement with those prepared on the basis of anatomical characters and data from other disciplines of botany (Metcalfe, 1961). The classification of pollen is based on number–position–character analysis known as "NPC system." An analysis based on combination fo these features provides a three dimensional classification. The NPC System helps in formulation of broad spread of dicotyledons and also in preparation of diagnoses below family level. Leading palynologists have studied

extensively the subject matter from this perspective. Palynological analysis of plants of Kashmir from taxonomic viewpoints is being studied (Lakhanpal, under publication). Pollen morphology of Indian vegetable crops has been dealt in some detail by Nair and Kapoor (1974). Diagnoses of certain angiospermic taxon of Indo-gangetic plains (Shukla)nee Awasthi, 1962) and elucidation of certain typical and abnormal sporomorphs (Shukla, 1975) are available. It is gratifying to record that recent classifications by Zimmermann and Cronquist have made exclusive use of pollen features as one of the strong characters in construction of taxonomic fabric of angiosperm classification.

A brief treatment of the subject matter with comments on families and other taxon diagnoses and future of palynology in relation to taxonomy has been presented here. The significance of pollen morphological attributes like apertural characters and NPC data in solving taxonomic problems has also been emphasized.

Palynology of Taxon Above Family Rank

Apertural characters of pollen grains have been looked upon to be of considerable importance in solving taxonomic problems. The NPC formula is applied and the NPC value, thus, computed is used in ascertaining taxonomic position. There is evidence of solutions offered by NPC formula application. It is recommended that taxon with generally some NPC formula be grouped together while those which show aberrant NPC separately. Families placed in Parietales in Engler and Diels (1936) classification when put to "palynological compass needle" based on NPC formula showed need to spread over the order Parietales into families–a suggestion further adopted by Hutchinson (1959). The pollen in Parietals are 3-tremes (N_3), zonotreme (P_4) and colporate (C_5). The NPC formula is approximately 345. A significant variance in one of the families of this order is shown by Canellaceae which has pollen with one distal colpus. The NPC formula of this family is 133. Similarly, lesser startling divergence in NPC formula occurs in Frankeniaceae and Tamarioaceae (NPC, 343). Families which exhibit such deviations in NPC formula like Canellanceae, Frankeniaceae, Tamaricaeae, Dilliniaceae, Dipterocarpaceae, Eucryphiaceae and Elatinaceae have been assigned different status by Hutchinson (1959) following recommendations based on NPC formula and alien palynological features. Likewise, order. Bixales bears general NPC 345. Achatocarpaceae bears a higher NPC and does not fit into the order. Hoplestigmataceae despite

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similar NPC shows difference in other palynological features and made its reference near Ehretiaceae (Hallier, 1910). Achatocarpaceae is referred to Centrospermae (Engler and Diels, 1936) on the basis of support from NPC analysis. The Centrospermoid dicotyledons present several apertural conditions when analysed for NPC. It suggest that in Centrospermae there are diverse lines of evolutions. Thus, palynological studies are of significance in elucidation of evolutionary course.

Palynology of Taxon Below Family Rank

Palynology could find a place of application in solving taxonomic differentiation below family rank. Thus, it could serve to identify sub-family, genera, sections and species. In this task NPC formula computed with XYZ or a hypothetical series of pollen features of sporoderm ultra structure and chemical and physical attributes are of considerable significance and could find wide application in modern taxonomy. For the sake of conveyance of readers this fact would find a treatment here with certain specific examples.

Sub-families : Problem of Acanthaceae–Thunbergioideae when evaluated on the basis of palynological treatment it suggested that Thunbergioideae should be assigned a special family status. This contention originated on the basis of anomotreme pollen grains beset with spiral apertures (Raj, 1961). Such apertural features and sporoderm nature are uncommon elsewhere in sub-families. These palynological facts led to support elevation of Thunbergiodeae to a special family rank. Likewise, there are other reports where palynology could provide better sub-family demarcation. Surprisingly, at several places. palynological contentions have been found in agreement with other disciplines of the subject matter.

Genera and sections : Taxonomic interetation has been promoted with regard to examples of *Abelia zabelia* and *Linnaea* genera related to genus *Morina* despite similarities in certain pollen features.

Species : Species segregation of genus could be helped following palynological analysis. There are keys to genera and species constructed for use in general taxonomy (Jeffrey, 1962; Shukla nee Awasthi, 1962).

Varieties : Nair and Kapoor (1974) reported wide range of variations in pollen features like aperture, size, exine, ornamentation, exine strata and shape. Such constant features marking variations may well be used in segregating of varieties of a large number of vegetable crop plants. There are similar reports on taxonomic significance of pollen features in varietal taxonomy of eight

varieties of *Cucurbita pepo* (Shukla nee Awasthi, 1962) and number of other plant species of Indo-Gangetic plains (Shukla nee Awasthi, 1962; Rao and Shukla; 1974).

Palynological Correlation of Families And Taxonomy

The application of palynological data has found usage in exclusive texts of Zimmermann and Cronquist. Erdtman (1963) has listed 105 families of particular interest to support correlation of palynology with taxonomy. A reference to this work may provide readers with a background, how these families present interesting examples showing palynological relation to taxonomy. It may be appreciated that still wide gaps exist in our knowledge to open frontiers for further research exploration and enquiry to supplement modern taxonomic concepts aided by palynological analysis.

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